DESCRIPTION

- ❖ In mathematics, a **PARTIAL DIFFERENTIAL EQUATION** (**PDE**) is a differential equation that contains unknown multivariable functions and their partial derivatives. (This is in contrast to ordinary differential equations, which deal with functions of a single variable and their derivatives.) PDEs are used to formulate problems involving functions of several variables, and are either solved by hand, or used to create a relevant computer model.
- ❖ PDEs can be used to describe a wide variety of phenomena such as sound, heat, electrostatics, electrodynamics, fluid flow, elasticity, or quantum mechanics. These seemingly distinct physical phenomena can be formalised similarly in terms of PDEs. Just as ordinary differential equations often model one-dimensional dynamical systems, partial differential equations often model multidimensional systems. PDEs find their generalisation in stochastic partial differential equations.
- ❖ In mathematics, a **FOURIER SERIES** (English pronunciation: /ˈfɔərieɪ/) decomposes periodic functions or periodic signals into the sum of a (possibly infinite) set of simple oscillating functions, namely sines and cosines (or complex exponentials). The Discrete-time Fourier transform is a periodic function, often defined in terms of a Fourier series. And the Z-transform reduces to a Fourier series for the important case |z|=1. Fourier series is also central to the original proof of the Nyquist–Shannon sampling theorem. The study of Fourier series is a branch of Fourier analysis.
- ❖ The **FOURIER TRANSFORM** (English pronunciation: /ˈfɔərieɪ/), named after Joseph Fourier, is a mathematical transformation employed to transform signals between time (or spatial) domain and frequency domain, which has many applications in physics and engineering. It is reversible, being able to transform from either domain to the other. The term itself refers to both the transform operation and to the function it produces.
- ❖ In the case of a periodic function over time (for example, a continuous but not necessarily sinusoidal musical sound), the Fourier transform can be simplified to the calculation of a discrete set of complex amplitudes, called Fourier series coefficients. They represent the frequency spectrum of the original time-domain signal. Also, when a time-domain function is sampled to facilitate storage or computer-processing, it is still possible to recreate a version of the original Fourier transform according to the Poisson summation formula, also known as discrete-time Fourier transform. See also Fourier analysis and List of Fourier-related transforms.
- ❖ In mathematics and signal processing, the **Z-TRANSFORM** converts a discrete-time signal, which is a sequence of real or complex numbers, into a complex frequency domain representation. It can be considered as a discrete-time equivalent of the Laplace transform. This similarity is explored in the theory of time scale calculus

OBJECTIVES

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

OUTCOMES

- The understanding of the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

MA6351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C 3 1 0 4

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

Formation of partial differential equations – Singular integrals -- Solutions of standard types of first order partial differential equations - Lagrange’s linear equation -- Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 9 + 3

Dirichlet‟s conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval‟s identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

Classification of PDE – Method of separation of variables - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

UNIT IV FOURIER TRANSFORMS 9 + 3

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval‟s identity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9 + 3

Z- Transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL (L:45+T:15): 60 PERIODS

TEXT BOOKS

1. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., Second reprint, New Delhi, 2012.
2. Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.
3. Narayanan.S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" Vol. II & III, S.Viswanathan Publishers Pvt Ltd. 1998.

REFERENCES

1. Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd, 2007.
2. Ramana.B.V., "Higher Engineering Mathematics", Tata Mc-Graw Hill Publishing Company Limited, New Delhi, 2008.
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
5. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics", Sixth Edition, Tata McGraw Hill Education Pvt Ltd, New Delhi, 2012.
6. Datta.K.B., "Mathematical Methods of Science and Engineering", Cengage Learning India Pvt Ltd, Delhi, 2013.

MICRO LESSON PLAN

WEEK	LECT. NO.	TOPICS TO BE COVERED	TEXT / REF. BOOKS
UNIT I PARTIAL DIFFERENTIAL EQUATIONS			
I	1,2	Formation of partial differential equations - Singular integrals	Tex. Book 1
	3,4	Solutions of standard types of first order partial differential equations	
	5	Lagrange’s linear equation	
II	6,7,8	Linear partial differential equations of Second order	
	9,10	Higher order with constant coefficients of homogeneous type	
III	11,12	non-homogeneous types	
UNIT IV FOURIER TRANSFORMS			
III	13,14	Statement of Fourier integral theorem	Tex. Book 1
	15	Fourier transform pair	
IV	16,17,18	Fourier sine and cosine transforms	
	19,20,21	Properties – Transforms of simple functions	
V	22,23	Convolution theorem	
	24	Parseval‟s identity	
UNIT II FOURIER SERIES			
V	25, 26	Dirichlet's conditions – General Fourier series –	Tex. Book 1
VI	27, 28	Odd and even functions	
	29, 30,31	Half range sine series – Half range cosine series	
VII	32	Complex form of Fourier series	
	33, 34	Parseval‟s identity – Harmonic analysis	
	35, 36	Harmonic analysis	
UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS			
VIII	37,38,39	Classification of PDE- Method of separation of variables	Tex. Book 1
	40,41,42	Solutions of one dimensional wave equation	
IX	43,44,45	One dimensional equation of heat conduction	
	46,47,48	Steady state solution of two dimensional equation of heat conduction (excluding insulated edges)	
UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS			
X	49, 50, 51	Z- Transforms - Elementary properties	Tex. Book 1
	52, 53, 54	Inverse Z - transform (using partial fraction and residues)	
XI	55 , 56	Convolution theorem	
	57, 58	Formation of difference equations	
	59, 60	Solution of difference equations using Z - transform.	

Prepared by,

Faculty Members / Mathematics